Los Angeles Trade Tech. Jr. College
Instructor: R.H. Oeffinger

AS-
LUCAS, A.

ELECTRONICS TECHNICIAN

ASSIGNMENT SHEET

Units

Materials: Cooke and Orleans, Mathematics Essential to Electricity and Radio, McGraw-Hill.

Introduction: The important point here is to understand the wide range in values that units have in electronics. A unit may vary from one extreme to the other--Megunit (one million times) to Micromicrounit (one-millionth of one-millionth).

Assignment: Study pages 53 to 58, chapter 8, Cooke's Math.

Test: Turn in work for the follwing problems in Cooke's Math.

Problems 8-1, all

1 - 2×10 ma, 2×10^4 ua.
2 - 3.42×10^6 ua, 3.42×10^3 ma
3 - 3.50×10^2 ma, 3.50×10^5 ua
4 - 4.2×10 mv, 4.2×10^4 uv, 4.2×10^{-5} Kv.
5 - 2.5×10^{-2} a, 2.5×10^4 ua.
6 - 2.5×10^{-10} f, 2.5×10^2 uuf.
7 - 3.58×10^5 mh, 3.58×10^{-1} h.
8 - 1.35×10^4 v, 1.35×10^{10} uv
9 - 1.5×10^{-4} h, 1.5×10^{-1} mh.
10 - 3.5×10^{-10} f, 3.5×10^{-4} uf.
11 - 4.5×10^3 Ω 4.5×10^9 uΩ
12 - 1.65×10^{-1} MΩ 1.65×10^{11} uΩ
13 - 2.5×10^{-1} Kw 2.5×10^5 mw
14 - 4.3×10^3 v, 4.3×10^6 mv
15 - 3.5×10^{-2} uf, 3.5×10^4 uuf.
16 - 3.64×10^4 w, 3.64×10^7 mw
17 - 3×10^{-11} f, 3×10^{-5} uf.
18 - 1.62×10^{-2} ma, 1.62×10^{-5} a
19 - 1.25×10^{-1} mh, 1.25×10^{-4} h
20 - 2×10^{-9} f, 2×10^3 uuf.
21 - 5×10^{-4} uf, 5×10^{-10} f.
22 - 6.5×10^{-2} mh, 6.5×10^5 uh
23 - 3×10^3 Ω, 3×10^9 uΩ

OVER →

24. — 1.25×10^{-5} a, 1.25×10^{-2} ma

25 — 2×10^{5} μV, 2×10^{2} mV.

26 — 10 Kc. 10^{-2} MC.

27 — 4.35×10^{6} ~, 4.35×10^{3} Mc.

27 — 4.135 MC 4.135×10^{6} ~

29 — 3.4×10^{4} μ mho.

30 — 1.26×10^{-3} mho.

Los Angeles Trade Tech. Jr. College
Instructor: R. H. Oeffinger

Technician: Lucas, Agustin
Date: Sept. 24 1956

ELECTRONICS TECHNICIAN
ASIGNMENT SHEET

D.C. Circuits Problems

Chapter 6. Page 63. TM-661.

a. Ohm's Law formulas: (1) $E = I.R$; (2) $I = \frac{E}{R}$; (3) $R = \frac{E}{I}$.

b. 8 Amps

c. 110 Ohms

d. 9 Volts

e. The Volt, The Amp. The Ohm.

f. The current is also doubled.

g. 110 Volts.

h. .04 Amps.

i. E, R, I.

j. The current decreases.

Chapter 9. Problems 1 to 8 Pages 108 to 111

Problem:

#1. Voltage drop across A 12 Volts.
Resistance of A 3 Ohms.
Resistance of E 9 Ohms.
Voltage drop across C 7.5 Volts.
Current through D 1.25 Amps.
Resistance of C 10 Ohms.
Current through B 2Amps.

2. A, Battery voltage, 18 Volts
B, Battery voltage, 6 Volts

3. A, I through A 2 Amps
E, E across A 12 Volts

B, Series circuit
Rt. 12 Ohms
Ia. 1 Amp
Ib. 1 Amp
Eb. 9 Volts
Sum of voltage drops; 9+3=12

C, IR drop of A 6 volts
Rb 3 Ohms
Eb 6 Volts
Rc 6 Ohms
Sum of voltage drops 12+6+6=24

D, Ea 1 Volt
Ec 3 Volts
Ic .5 Amps
Rb 4 Ohms
Rc 6 Ohms

(over)

Problem:

#4. E, Paralell circuit

Rt. 1 Ohm	Ib. 3 Amps
It. 12 Amps	Ic. 2 Amps
Ia. 6 Amps	Id. 1 Amp

IR drop of each branch 12 Volts

F, Paralell circuit

Rt. 2.4 Ohms	Ib. 2 Amps
It. 10 Amps	Ea. 24 Volts
Ia. 8 Amps	Eb. 24 Volts

G, Rt. 2 Ohms — Id. 4 Amps
It. 12 Amps — Rd. 6 Ohms
Ib. 4 Amps — Ra. 8 Ohms
Ic. 1 Amp — Ia. 5 Amps

#5. H, Series paralell circuit

Ea. 1 Volt	Ib. 1.5 Amps
Ed. 1 Volt	Id. 2 Amps
Eb. 6 Volts	Rc. 12 Ohms

J, Rt. 10 Ohms — Ee. 4.8 Volts
It. 2.4 Amps — Ef. 4.8 Volts
Ia. 2.4 Amps — If. .8 Amps
Ib, 2.4 Amps — Ig. .4 Amps
Ec. 12 Volts — Eh. 1.6 Volts
Ic. 1.2 Amps — Ic. + If. + Ih = 2.4 Amps
Id. 1.2 Amps — Ea. + Ec. + Eb. = 24 Volts
Ed. 2.4 Volts — Ea. + Ed. + Ef. + Ee. + Eb = 24 volts
Ie. 1.2 Amps — Ea. + Ed. + Eg. + Eh. + Ei. + Ee. + Eb = 24 Volts

#6. K, Rt, 12 Ohms — If. 1.33 Amps
It. 4.5 Amps — Ig. .66 Amps
Ea. 4.5 Volts — Ih. 2 Amps
Ib. 4.5 Amps — Ef. 8 Volts
Ec. 36 Volts — Eg. 8 Volts
Id. 3 Amps — Ea. + Ec. + Eb. = 54 Volts
Ee. 24 Volts — Ea. + Ed. + Ee. + Eb. = 54 Volts
Ia. 1 Amp — Ea. + Ed. + Ef. + Eh. + Ei. + Eb. = 54 Volts

L, Ea. 24 volts — Rd. 2 Amps
Ec. 30 Volts — Ih. 2 Amps
Rb. 2 Ohms — If. 1 Amp
Ic. 5 Amps — Rf. 12 Ohms
Ie. 3 Amps — Ri. 2 Ohms
Ee. 12 volts — Eg. 6 Volts
Ed. 6 Volts

#7. M, Rt, 25 Ohms — Ef. 20 Volts — Ef. 60 Volts
It. 8 Amps — Ib. 4 Amps — Ie. 2 Amps
Ia. 8 Amps — Ic. 2 Amps — Ig. 2 Amps
Ea. 100 Volts — If. 2 Amps — Eg. 30 Volts
Eb. 80 Volts — Id. 4 Amps — Eh. 16 Volts
Ec. 20 Volt — Ed. 40 Volts — Ei. 14 volts

(Over)

Problem:

#7. N, Paralell circuit

Rt. 1 Ohm	Eb. 3 Volts
It. 3 Amps	Ib. 1 Amp
Ea. 3 Volts	Ec. 3 Volts
Ia. 1 Amp	Ic. 1 Amp

#8. P, Series paralell circuit

Rt. 8 Ohms	Ib. .25 Amps
Ia. .5 Amps	Eb. 2 Volts
Ea. 2 Volts	Ic. .25 Amps
It. .5 Amps	Ec. 2 Volts

Q,

Rt. 24 Ohms	Ib. 3.6 Amps	Ii. .48 Amps
It. 6Amps	Ie. 2.4 Amps	Il. 1.44 Amps
Ia. 6 Amps	Ee. 19.2 Volts	El. 12.96 Volts
Ea. 36 Volts	Ig. 2.4 Amps	Ek. 4.32 Volts
Ec. 36 Volts	Eg. 24 Volts	Ik. .72 Amps
Ed. 36 Volts	Ef. 28.8 Volts	Ij. .36 Amps
Ic. 3 Amps	If. .96 Amps	Im. .36 Amps
Id. 3 Amps	Eh. 11.52 Volts	Em. 2.88 Volts
Eb. 72 Volts	Ih. .96 Amps	En. 1.44 Volts

Chapter 2, PRoblems 46, 47, and 48 of Henney book

#46. On the first part of this problem, since the internal resistance is so small compared to the external resistance, it can be left out of the calculations. The error will be very small, by actual caculation, the voltage drop in the battery itself will be ; .018 volts. So we can say that, on the first part of the problem the volt meter will read 45 volts.
On the second part, it will read: 37.5 Volts, since 7.5 volts are droped in the internal resistance.
Total resistance $100+20=120$ OHMS
Current drawn $\frac{45}{120} = .375$ amps
Voltage across the meter $100 \times .375 = 37.5$ Volts

#47. Cost per Kilowat-Hour:
$90 \times .015 = 1.35$ Watts; $780 \times 1.35 = 1053$ Watt-Hours
$1053 : 1000 = 1.053$ Kilowatt-hours per battery
$\$2 : 1.053 = \$1.89$ per Kilowatt-Hour
$1.25 \times 1.25 \times 4 = 6.24$ Cubic inches per cell
$6000 \times 6.24 = 37,440$ Total cubic inches (21 cubic ft.,1152 cubic in.)
$6 \times 10^3 \times 3.66 \times 10^{-1} = 2196$ lb.

#48 $1.75 \times 6 = 10.5$ Volts; Lead-Acid cells needed 6
$1 \times 10 = 10$ volts; Alkaline cells needed 10
$10 : 3.25 = 3.07$ Ohms for both batteries

Lucas, Aguustin

Sept. 26 1956

ELECTRONICS TECHNICIAN

TECHNICAL REPORT

Title: Ammeter and Meter Resistance

Before an unknown meter can be connected in a circuit, certain facts must be determined. Such as, the internal resistance and maximum current range. Both of these facts can be easily FOUND by putting in application the laws of series and paralell D.C. circuits.

In this experiment, such an unknown meter was used. The first fact to be found was the maximum current range. To do this, the meter was connected in series with a high resistance to a 6 volts battery, the resistance was then decreased untill full deflection was noted in the meter. At this time, since the meter and resistor were connected in series, the same amount of current was flowing through both. The resistor was then measured and found to be of a value of 3100 ohms. Thus, by Ohm's Law ($I=\frac{E}{R}$), The current: $\frac{6}{3100}=.002$ Amps, and this is the maximum meter current, or current needed for full meter deflection.

To find the meter resistance, a 50 ohms variable resistor was connected in paralell with the meter, and adjusted till half meter deflection was obtain. This indicated that the .002 amps were divided equally through the meter and resistor. By measuring the resistor we found the meter resistance to be 20 ohms. Since the current divided equally, being a paralell circuit, then the resistances must be equal. By Ohm's Law: $E=I \times R$, the voltage drop across the meter at full scale deflection was: $.002 \times 20 = .04$ volts.

To construct a 1 amp ammeter with the same meter, we changed the series resistor to a value of 6 ohms. Having a source of 6 volts, ($I=\frac{E}{R}$) 1 amp was now flowing in the circuit. Since the maximum current through the meter must be .002 amps, a path for the rest of the current must be provided. This was done by putting a shunt resistor across the meter. The value of this resistor was found by: ($R=\frac{E}{I}$), $\frac{.04}{.998}=.04$ ohms. .04 voltage drop across the meter. .998 amps through the shunt.
A lengh of nicrome resistance wire was measured and calculated to have a resistance of .5 ohms per inch. Five lenghs of 2 inches were connected in paralell with the meter to give us .04 ohms and full scale deflection of the meter with 1 amp flowing in the circuit.

LUCAS, AGUSTIN

POWERS OF TEN

7-1

1. $643,000,000 = 6.43 \times 10^{8}$
2. $4356 = 4.356 \times 10^{3}$
3. $.0136 = 1.36 \times 10^{-2}$
4. $14 = 1.4 \times 10^{1}$
5. $.000250 = 2.5 \times 10^{-4}$
6. [illegible]
7. [illegible]
8. $.000,000643 = 6.43 \times 10^{-7}$
9. [illegible]
10. $59300 = 5.93 \times 10^{4}$
11. [illegible]
12. $1890 \times 10^{3} = 1.89 = 10^{6}$
13. [illegible]
14. $.000086 \times 10^{-6} = 8.6 \times 10^{-1}$
15. [illegible]
16. $1,684,000,000 = 1.684 \times 10^{9}$
17. [illegible]
18. $8420 \times 10^{-12} = 8.42 \times 10^{-9}$
19. [illegible]
20. [illegible]

7-2

1. $10,000 \times .0001 \times 100.000 = 10^{4} \times 10^{-4} \times 10^{5} = 10^{5}$
2. $.00001 \times 10^{5} \times 1000 = 10^{-5} \times 10^{5} \times 10^{3} = 10^{3}$
3. $104,000 \times .00025 = 1.04 \times 10^{5} \times 2.5 \times 10^{-4} = 2.6 \times 10^{1}$
4. $23 \times 10^{8} \times 45 \times 10^{-3} \times 2 \times 10^{-7} = 2.3 \times 4.5 \times 2 = 2.07 \times 10$
5. $.00000084 \times .0005 \times .000017 = 8.4 \times 10^{-7} \times 5 \times 10^{-4} \times 1.7 \times 10^{-5} = 7.14 \times 10^{-16}$
6. $68,000,000 \times .00000035 \times .00005 = 6.8 \times 10^{7} \times 3.5 \times 10^{-7} \times 5.5 \times 10^{-5} = 1.3 \times 10^{-3}$
7. [illegible]
8. $782 \times 10^{-8} \times 500 \times 10^{4} \times .0003717 \times 10^{-6} = 7.82 \times 5 \times 3.7 \times 10^{-11} = 1.45 \times 10^{-9}$
9. $38.6 \times 10^{-3} \times .485 \times 10^{2} \times 4930 \times 10^{-12} = 3.86 \times 4.85 \times 4.93 \times 10^{-5} = 9.23 \times 10^{-5}$
10. $.00000000793 \times 10^{-4} \times 597,000 \times 683 \times 10^{8} \times 3 \times 10^{-6} =$
    $= 7.93 \times 5.97 \times 6.83 \times 3 \times 10^{-12} = 9.70 \times 10^{-2}$

7.3

1. $\frac{.000025}{5000} = \frac{2.5 \times 10^{-5}}{5 \times 10^{3}} = \frac{2.5}{5} \times 10^{-8} =$

2. $\frac{1}{\quad} = \frac{1}{1.1 \times 8 \times 10^{-1}} = \frac{1 \times 10}{\quad} = 1.0$

3. $\frac{\quad}{\quad} = \frac{\quad}{\quad} =$

4. $\frac{1}{6.28 \times 1550 \times 10^{3} \times 452 \times 10^{-7}} = \frac{1}{6.28 \times 1.55 \times 4.52 \times 10^{1}} =$

5. $\frac{1.59 \times 10^{3}}{5.6 \times 10^{-2} \times 2.50 \times 10^{-12}} = \frac{1.59}{5.6 \times 2.50} \times 10^{19} = 1.14 \times 10^{19}$

6. $\frac{1}{6.28 \times 500 \times 10^{-12} \times 750} = \frac{1}{6.28 \times 5 \times 7.5} \times 10^{9} = 4.25 \times$

7. $\frac{5.93 \times 10^{6} \times 7.93 \times 10^{7}}{4.7 \times 10^{10} \times 7.8 \times 10^{7}} = \frac{5.93 \times 7.93}{3.7 \times 7.8} \times 10^{-4} = 1.63 \times 10^{-4}$

8. $\frac{\quad}{\quad} = \frac{\quad}{\quad} \times 10^{-1} =$

9. $\frac{\quad}{\quad} = \frac{5.8 \times 9.83}{7.1} \times 10^{-1} = 8.03 \times 10^{-1}$

10. $\frac{1}{248.000 \times 563 \times 10^{-3} \times .0000903} = \frac{1}{2.48 \times 5.63 \times 9} \times 10^{4} = 7.9 \times 10^{-2}$

11. $\frac{\quad}{72 \times .0624 \times .0363} = \frac{1.71 \times 1.30 \times 3.0}{7.2 \times 6.24 \times 3.53} \times 10^{6} = 5 \times 10^{2}$

12. $\frac{\quad}{.0477 \times 12.3 \times .0000203} = \frac{\quad}{4.77 \times 1.23 \times 6.03} \times 10^{6} = 1.63 \times 10^{1}$

13. $\frac{1}{\quad} = \frac{1}{\quad} \times 10^{5} =$

14. $\frac{1}{\quad \times \quad \times 9.63 \times 10^{-5}} = \frac{1}{3.46 \times 8 \times 6.2 \times 9.63} \times 10^{-3} = 6.0 \times 10^{-7}$

15. $\frac{104.000 \times 8.30 \times 10^{-4} \times \quad}{\quad} = \frac{1.06 \times 8.3 \times 2.18}{2.3 \times 3.84} \times 10^{-8} = 6.5 \times 10^{-8}$

16. $\frac{\quad}{31,000 \times .00200 \times .682 \times 10^{4}} = \frac{\quad}{3.12 \times 7 \times 6.82} \times 10^{1} =$

17. $\frac{15.100 \times 444 \times 10^{-3} \times .00}{84.5 \times 10^{-5} \times 382 \times 10^{-1}} = \frac{1.51 \times \quad}{8.45 \times 3.82} \times 10^{3} =$

18. $\frac{.000413 \times 7830 \times 10^{-8}}{1.24 \times 10^{-7} \times .0000007} = \frac{\quad}{\quad} \times 10^{10} = 1.99 \times 10^{10}$

cont: 7-3

11. $\frac{1}{6.28 \times 4.25 \times 6.19} = \frac{1}{6.28 \times 4.85 \times 6.19} \times 10^{-1} = 5.34 \times 10^{-1}$

12. $\frac{1.59 \times 10^{3}}{5.5 \times 10^{-6} \times 3.10 \times 10^{-12}} = \frac{1.59}{5.5 \times 3.1} \times 10^{23} = 9.3 \times 10^{22}$

7-4

1. $(10^4)^3 = 10^{4\times3} = 10^{12}$
2. $(10^2 \times 10^3)^3 = (10^5)^3 = 10^{5\times3} = 10^{15}$
3. $(10^{-3})^4 = 10^{-3\times4} = 10^{-12}$
4. $(3 \times 10^{-3})^2 = 3 \times 3 \times 10^{-6} = 9 \times 10^{-6}$
5. $(5 \times 10^4)^3 = 5^3 \times 10^{12} = 1.25 \times 10^{14}$
6. $(7 \times 10^{-3})^3 = 7^3 \times 10^{-9} = 3.43 \times 10^{-7}$
7. $(8 \times 10^4 \times 2 \times 10^5)^2 = 8^2 \times 2^2 \times 10^{18} = 2.56 \times 10^{20}$
8. $\left(\frac{8 \times 10^4}{2 \times 10^3}\right)^2 = \left(\frac{40 \times 10^4}{4 \times 10^6}\right) = \frac{40}{4} \times 10^{-2} = 1.1 \times 10^{3}$
9. $\sqrt{.0025 \times .00004} = \sqrt{2.5 \times 4 \times 10^{-7}} = \sqrt{100 \times 10^{-6}} = \sqrt{\frac{10 \times 10^{-3}}{100}}$
10. $\sqrt{5.0441 \times 10^{-7}} = \sqrt{7.1 \times 7 \times 10^{-4}} = \sqrt{7.1 \times 10^{-3}} = \sqrt{\frac{2.7 \times 10^{-3}}{7.3}}$
11. $\sqrt{6.4 \times 10^{-4} \times 12.5 \times 10^{10}} = \sqrt{16 \times 10^{6}} = \sqrt{\frac{4 \times 10^{3}}{16}}$
12. $\frac{1}{6.28\sqrt{4 \times 10^{3} \times 4.7 \times 10^{-8}}} = \frac{1}{6.28 \times 1.37 \times 10^{-2}} = \frac{1}{8.6 \times 10^{-2}}$

$= \frac{1}{6.28 \times 1.67} \times 10^{1} = 9.6 \times 10^{-1}$

13. $\frac{1.59 \times 10^{3}}{\sqrt{4.5 \times 10^{-5} \times 2.5 \times 10^{-10}}} = \frac{1.59 \times 10^{3}}{\sqrt{1.13 \times 10^{-14}}} = \frac{1.59}{1.13} \times 10^{10} = 1.5 \times 10^{10}$

14. $\frac{1.59 \times 10^{5}}{\sqrt{1.59 \times 10^{-8} \times 1.5 \times 10^{-14}}} = \frac{1.59 \times 10^{7}}{\sqrt{1.59 \times 1.5 \times 10^{-22}}} = \frac{1.59}{1.55} \times 10^{12} = 6.5 \times 10^{11}$

15. $\left(\frac{6.3 \times 10^{3} \times 4.6 \times 10^{-9}}{5.1 \times 10^{-5}}\right)^2 = \left(\frac{6.3 \times 4.6 \times 10^{-9}}{5.1 \times 10^{-5}}\right)^2 = \left(\frac{6.3 \times 4.6}{5.1} \times 10^{3}\right)^2 =$

$= \left(\frac{6.3 \times 4.6}{5.1}\right)^2 \times 10^{6} = (5.7)^2 \times 10^{6} = 3.23 \times 10^{7}$

LUCAS, AGUSTIN.

COCHE'S MATH. CHAP. 2

LITERAL NUMBERS

EXERCISE 2-1, ODD

1. $8 \times E$; $3 \times i$; $V \times R$.

3. $7 \times 3 = 21$; $3 \cdot N$ [illegible]

5. $\frac{2.50}{N}$; $\frac{2.50}{Q}$

7. $\frac{x}{2}$

9. $\frac{I}{2}$; $\frac{I}{2} \times 3$; $\frac{3I}{2} \times 10 = 1.5I \times 10 = 15I$.

11. $a = 2$; $b = 8$; $c = 5$

(a) $-5 + 8 = 13$; (b) $-8 - 2 - 5 = 5$; (c) $-2 \times 8 \times 5 = 80$

(d) $-\frac{8}{2} = 4$; (e) $-\frac{2+1}{5} = 2$; (f) $-8 \times 5 - 3 \times 5 = 10$

(g) $\frac{8+6\times2}{2\times5} = 2.8$; (h) $\frac{2\times2\times5\times5}{5} = 32$;

(i) $\frac{24\times8\times2}{7\times5} = 10.9$

13. $12 \times 5 - I$

15. $I = I_1 + 25$; $I_1 = I - 25$

EXERCISE 2-2, EVEN

2. $i^5 = 32$

4. $6 \times 3 \times 3 = 54$

6. $4 \times 5 \times 5 \times 5 = 500$

8. $6(3 \times 3)(5)5 = 900$

10. $3 \times 3 \times 3 \times 2 \times 2 \times 2 \times 2 \times 5 = 2160$

12. $\frac{4}{2\times25} - \frac{1}{8\times5} = .08 - 025 = .055$

14. $3.14 \times 3 \times 3 = 28.26$

16. $\frac{10 \times 3.14 \times 16}{3} = 167.46$

19. (a) $25 \times 6 = 150$ WATTS

(b) $.0004 \times 5000 = 4 \times 5 \times 10^{-1} = 20 \times 10^{-1} = 2$ WATTS

$20 \times \frac{12100}{200} = \frac{1.21 \times 10^4}{2 \times 10^2} = \frac{1.21}{2} \times 10^2 = 6.05 \times 10^1 = 60.5$ W.

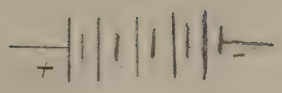
(b) $\frac{4840}{50} = \frac{4.84 \times 10^3}{5 \times 10} = \frac{4.84}{5} \times 10^2 = 9.68 \times 10^2 = 968$ W

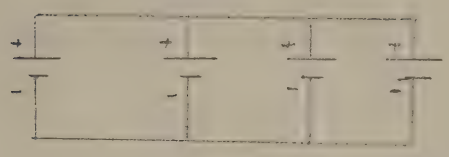
22. $6.28 \times 10^5 = 628{,}000$

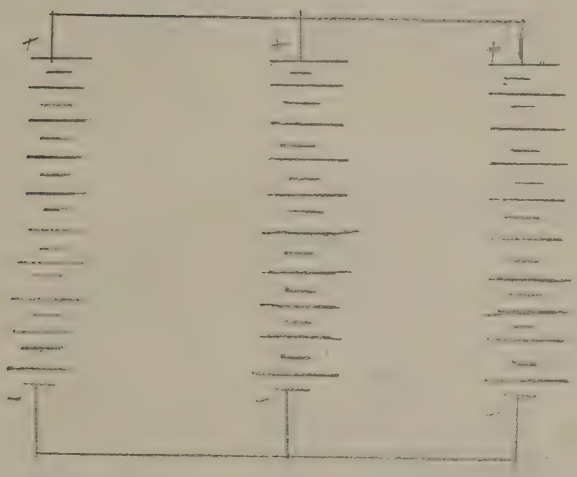
24. FOUR TIMES LARGER

26. (a) QUADRUPLED; b. 9 TIMES MORE; (c) 16 TIMES MORE

ac.







ad. EMF = 9 VOLTS. INT F[illegible]

9 ÷ 2.27 [illegible]

2.27 × 1,47 = 6.5 [illegible]

ae. A' BATTERY [illegible]

B' [illegible]

C' VERE LOW [illegible]

LUCAS AGUSTIN

COOKE MATH. CHAPTER 3-4-5

EXERCISE 3-3.

1. $5X + 6X - 12X + 33X = 33X$

2. $3a^2 - 13a^2 + a^2 - 4a^2 = -13a^2$

3. $5ab - 7ab - 2ab - ab = -3ab$

4. $11RI^2 + RI^2 + 4RI^2 = 16RI^2$

5. $12ei - 14ei + ei - 4ei = 0ei$

6. $12iz - iz - 6iz + 8iz = 13iz$

7. $3a^2b + 6a^2b - 8a^2b + 2a^2b = 3a^2b$

8.
$$\begin{array}{r} 3x - 2y + 5z \\ -4x - 8y + 6z \\ \hline -x - 10y + 11z \end{array}$$

9.
$$\begin{array}{r} 4x - 3a - 3c - 11 \\ -3x + 2a + 4c \\ \hline x - a + c - 11 \end{array}$$

10.
$$\begin{array}{r} x^2 - 7x - 10 \\ 3x^2 + 14x - 8 \\ \hline 4x^2 + 7x - 18 \end{array}$$

11.
$$\begin{array}{r} x^2 + 5x - 6 \\ 8x^2 \quad -4 \\ -2x^2 - 3x + 5 \\ \hline 7x^2 + 2x - 4 \end{array}$$

12.
$$\begin{array}{r} 7c - 2a - 10 \\ 9 - a + 11 - 2x \\ -3c + a + x \\ 3c + 3a - 7 \\ \hline 9c + a - 6 - x \end{array}$$

SUBTRACT

13. $6x^4 - 3x^4 = 3x^4$

14. $2a^2 - 5a^2 = -3a^2$

15. $3ab + 7ab = 10ab$

16. illegible

17.
$$\begin{array}{r} x + 4y \\ -2x + 3y \\ \hline -x + 7y \end{array}$$

18.
$$\begin{array}{r} -4x - 8y + 6z \\ -3x + 2y - 5z \\ \hline -7x - 6y + z \end{array}$$

19.
$$\begin{array}{r} 14x - 8 + 3x^2 \\ +7x - 10 - x^2 \\ \hline -21x - 18 + 2x^2 \end{array}$$

20. $8IR + 9E - 4Ix - 6$

21. $5w + 7EI + 1 + 7I^2R$.

22. $x - 3x^2 + 3$

23. $5.54x^2 - 8.9x$

24. $.9y^3 + .6x$

25. $6xI + 6E$
$-4xF + 10E$
$-17xI + 16E$

$4xI + 6E$
$21xI - 10E$
$25xI - 4E$

27. $16xI + 2E - 11RI$
$-3x - 3E + 9RI$
$+22xI - E - 2RI$

$16xI + 2E - 10RI$
$-6xI + 3E - 8RI$
$+10xI + 5E - 18RI$

28. $2w + 4EI - 13RI^2$
$-4w + 8EI - 14RI^2$
$-2w + 12EI - 27RI^2$

$2w + 4EI - 13RI^2$
$-w - 8EI + 14RI^2$
$6w - 4EI + RI^2$

29. $1 + a^3 - a^2 - a$
$1 - a^3 - 3a^2 + 3a$
$2 - 4a^2 + 2a$

$2 - 4a^2 + 2a$
$-2 + a^2 - 4a - 3a^3$
$-3a^2 - 2a - 3a^3$

30. $36x^2 + 3y^2 - 21xy$
$-16x^2 - 9y^2 + 2xy$
$20x^2 - 6y^2 - 19xy$

31. $-x^2 + y^2$

32. $1 - a^2 - 2ab - b^2$

33. $.0c2b^2 - 2.1a^2 + 6.15ab$
$.01a^2 - 3.4a^2 - 6.02ab$
$.0128b^2 - 5.5a^2 + .34ab$

34. $.003E.I + 6.025^2 - 3.46w$
$-.003E.I + .3.975^2 - 8.53w$
$-.0011^2 + 63.115^2 - 12.09w$

EXCERCISE 4-3 – MULTIPLICATION

1. $4 + 3x \cdot x = 4x + 3x^2$
2. $x^2 - 3x \cdot 2x = 2x^3 - 6x^2$
3. $3a^2 - 2a \cdot 5a = 15a^3 - 10a^2$
4. $x - xy \cdot 2xy = 2x^2y - 2x^2y^2$
5. $R_1 + 2R_2 \cdot 3I = 3R_1I + 6R_2I$
6. $2c^2 - 3I^2 \cdot 2R = 4c^2R - 6I^2R$
7. $x^2 - x - 3 \cdot -1 = -x^2 + x + 3$
8. $x^2 - 4y - 2 \cdot 4y = 4x^2y - 16y^2 - 8y$
9. $3(2x - 1) = 6x - 3$
10. $-5(4y + 7) = -20y - 35$
11. $5c^2(2c^2 - 4c - 3) = 10c^4 - 20c^3 - 15c^2$
12. $5b^2(-3b^2 + 4b - 3) = -15b^4 + 20b^3 - 15b^2$
13. $-2y(1 - 2y + 3y^2) = -2y + 4y^2 - 6y^3$
14. $x(3x^2 - 2x + 5) = 3x^3 - 2x^2 + 5x$
15. $4\left(\frac{a}{2} - \frac{b}{4} + \frac{c}{8}\right) = 4\left(\frac{4a}{8} - \frac{2b}{8} + \frac{c}{8}\right) = \frac{16a}{8} - \frac{8b}{8} + \frac{4c}{8} = 2a - b - \frac{c}{2}$
16. $16\left(\frac{x}{4} + \frac{1}{8} - \frac{3y}{2}\right) = 16\left(\frac{2x}{8} + \frac{1}{8} - \frac{12y}{8}\right) = \frac{32x}{8} + \frac{16}{8} - \frac{192y}{8} = 4x + 2 - 24y$
17. $15\left(\frac{3b^2}{5} + \frac{b}{2} - \frac{2}{3}\right) = 15\left(\frac{18b^2}{30} + \frac{15b}{30} - \frac{20}{30}\right) = \frac{270b^2}{30} + \frac{225b}{30} - \frac{300}{30} =$
$= 9b^2 + 7.5b - 10$
18. $12\left(\frac{s^2}{3} - \frac{s}{2} + \frac{1}{4}\right) = 12\left(\frac{4s^2}{12} - \frac{6s}{12} + \frac{3}{12}\right) = \frac{48s^2}{12} - \frac{72s}{12} + \frac{36}{12} =$
$= 4s^2 - 6s + 3$

EXERCISE 4-5 MULTIPLICATION

11. $a+4$ times $a+3$

a^2+4a

$3a+12$

$a^2+7a+12$

12. $4c+7$ times $3c+2$

$12c^2+21c$

$+8c+14$

$12c^2+29c+14$

13. $3i-5$ times $3i+8$

$9i^2-15i$

$24i-40$

$9i^2+9i-40$

14. $3R-2$ times $2r+4$

$6r^2-4r$

$+12r-8$

$6r^2+8r-8$

15. $5-3Y$ times $5-4Y$

$30-15Y$

$-24Y+12Y^2$

$30-39Y+12Y^2$

16. $2X+Y$ times $X-4Y$

$2X^2+XY$

$-8XY-4Y^2$

$2X^2-7XY-4Y^2$

17. $2a-3b$ times $3a-2b$

$6a^2-9ab$

$-4ab+6b^2$

$6a^2-13ab+6b^2$

18. $3b-2$ times $2b-6$

$6b^2-4b$

$-18b+12$

$6b^2-22b+12$

19. $6x-b$ times $x+b$

$6x^2-xb$

$+6xb-b^2$

$6x^2+5xb-b^2$

20. $3a+2b^2$ times $4a-b^2$

$12a^2+8ab^2$

$-3ab^2-2b^4$

$12a^2+5ab^2-2b^4$

21. $2a^2-6b$ times $5a^2-3b$

$10a^4-30ba^2$

$-6ba^2+18b^2$

$10a^4-36ba^2+18b^2$

22. $\frac{1}{3}x+\frac{1}{4}y$ times $\frac{1}{3}x-\frac{1}{4}y$

$\frac{1}{9}x^2+\frac{1}{12}xy$

$-\frac{1}{12}xy-\frac{1}{16}y^2$

$\frac{1}{9}x^2+0-\frac{1}{16}y^2$

23. $3a^2-4a-7$ times $a-3$

$3a^3-4a^2-7a$

$-9a^2-12a-21$

$3a^3+5a^2-19a-21$

EXERCISE 4-5 (CONTINUED)

24. $3a^2 - 5a - 1$

$a + 2$

$3a^3 - 5a^2 - 1a$

$+6a^2 - 10a - 2$

$3a^3 + a^2 - 11a - 2$

25. $x^2 - xy + y^2$

$x + y$

$x^3 - x^2y + xy^2$

$+x^2y - xy^2 + y^3$

$x^3 \quad 0 \quad 0 + y^3$

25. $x^2 - xy + y^2$

$x + y$

$x^3 - x^2y + xy^2$

$+x^2y - xy^2 + y^3$

$x^3 \quad 0 \quad 0 + y^3$

26. $a^2 + 2ab + b^2$

$a + b$

$a^3 + 2a^2b + ab^2$

$+ a^2b + 2ab^2 + b^3$

$a^3 + 3a^2b + 3ab^2 + b^3$

27. $\frac{2}{3}a - \frac{3}{4}b$

$\frac{3}{2}a - \frac{4}{3}b$

$\frac{6}{6}a^2 - \frac{1}{8}ab$

$- \frac{8}{9}ab + \frac{12}{12}b^2$

$a^2 - \frac{145ab}{72} + b^2$

28. $a^2 + 5ab - b^2$

$a - b$

$a^3 + 5a^2b - ab^2$

$- a^2b - 5ab^2 + b^3$

$a^3 + 4a^2b - 6ab^2 + b^3$

29. $x - 2$

$x - 3$

$x^2 - 2x$

$- 3x + 6$

$x^2 - 5x + 6$

$x - 1$

$x^3 - 5x^2 + 6x$

$- x^2 + 5x - 6$

$x^3 - 6x^2 + 11x - 6$

30. $x + 5$

$x - 6$

$x^2 + 5x$

$- 6x - 30$

$x^2 - x - 30$

$x + 2$

$x^3 - x^2 - 30x$

$+ 2x^2 - 2x - 60$

$x^3 + x^2 - 32x - 60$

EXERCISE 5-3 — DIVIS

1. $x^0 = 1$ 3. $5^0 = 1$ 5. $(2a)^0 = 1$

7. $5(3)^0 = 5$ 9. $1^0 = 1$ 11. $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$

13. $a^{-3} = \frac{1}{a^3} = \frac{1}{a^4}$ 15. $3(2^{-2}) = 3\left(\frac{1}{2^2}\right) = 3\frac{1}{4} = \frac{3}{4}$

17. $\frac{1}{2^{-3}} = \frac{2^3}{1^3} = \frac{8}{1} = 8$ 19. $\left(\frac{2}{3}\right)^{-2} = \frac{1}{\frac{2^2}{3^2}} = \frac{1}{\frac{4}{9}} = \frac{9}{4} = 1\frac{1}{4}$

21. $(-3)^{-2} = \frac{1}{3^2} = \frac{1}{9}$ 23. $(-2)^{-6} = \frac{1}{64}$

25. $3^{-2} + 3^{-2} = 2 \cdot 3^{-2} = \frac{2}{9}$ 27. $3^{-2} + 2^{-3} = \frac{1}{9} + \frac{1}{8} = \frac{17}{72}$

29. $\frac{1}{3^{-1}} = \frac{1}{\frac{1}{3}} = 3$ 31. $\frac{1}{x^{-2}} = \frac{1}{\frac{1}{x^2}} = x^2$

33. $\frac{4a}{x^{-1}} = \frac{1}{\frac{4a}{x^{+1}}} = 4ax$ 35. $\frac{3m}{n^{-2}} = \frac{1}{\frac{3m}{n^2}} = \frac{n^2}{3m}$

37. $\frac{3^{-2}}{2^{-3}} = \frac{1}{9} \times \frac{8}{1} = \frac{8}{9}$ 39. $\frac{1}{3^{-2}} = 1 \times 3^2 = 9$

41. $9\frac{1}{2^2} = \frac{8}{8} = \frac{1}{2}$

EXERCISE 5-4 ODD

1. $\frac{2x - 4y}{2} = x - 2y$ 3. $\frac{6a - 2b}{3} = 2a - \frac{2}{3}b$

5. $\frac{12m^3 - 18m^2}{3m^2} = 4m - 3$ 7. $\frac{a^5 - a^3}{-a^4} = -a + a^{-1}$

9. $\frac{mn - m^2}{mn} = 1 - m$ 11. $\frac{3x^2 - 6x + 3}{3} = x^2 - 2x + 1$

13. $\frac{-a - 1 - b + a^2 + ab}{-a} = -a + a^2 + b + 1 - \frac{b}{a}$

15. $\frac{-6x^4 - 3x^3 + 9x^2}{-3x^2} = -2x^2 + x - 3$

17. $\frac{x^3 - 3x^2 - 3x}{x^2 - 2x} = x + 1 - \frac{3}{x^2 - 2x}$

7. $3a-2b \;\overline{)\,18a^2+9ab-2b}$

$18a^2-12ab$

$0 \quad 21ab-2b$

$21ab-14b^2$

$0 \quad 12b^2$

$= 6a+2b+\frac{12b^2}{3a-2b}$

8. $2b-3 \;\overline{)\,6b^2-7b-3}$

$6b^2-9b$

$= 3b+1$

$$(2Y^2 - 5Y - 12) \div (2Y + 3) = Y - 4$$

$$(12X^2 - 11XY - 35Y^2) \div (3X + 5Y) = 4X - 7Y$$

$$(a^3 + 7a^2 + 13a + 6) \div (a + 1) = a^2 + 6a + 7 - \frac{1}{a+1}$$

$$(2a^3 + a^2 - 13a + 6) \div (2a - 1) = a^2 + a - 6$$

$$(X^2 - Y^2) \div (X + Y) = X - Y$$

$$(X^2 - Y^2) \div (X - Y) = X + Y$$

$$(X^3 - Y^3) \div (X - Y) = X^2 + XY + Y^2$$

LUCAS, AGUSTIN

EXC. 6-1 ODD.

1. $2x = 12$, $x = 6$ 3. $\frac{1}{3}x = 10$ $x = 30$

5. $x - 1 = 3$; $x = 4$ 7. $2x + 5 = 8$ $x = 1.5$

9. $x + 2 = 7$ - $x = 5$ 11. $x + 7 = 10$ $x = 3$

13. $3x - 4 = 10$ $x = 4\frac{2}{3}$ 15. $\frac{1}{4}x = 5$ $x = 20$

17. $\frac{1}{5}x = 8$ $x = 40$ 19. $y + 1.3 = 1.8$ $y = .5$

21. $2x - 3 = 1.5$ $x = 1$ 23. [illegible]

25. [illegible] $= .85$ 27. $x - (-.1) = 0.5$ $x = .3$

$.5 = 0.5$ T

EXC - 6-2 ODD

1. $4y - 1 = 3y + 3$; $4y - 3y = 1 + 3$ $= 1y = 4$ $= y = 4$

3. $1 - 9i = -6i - 2$; $-9i + 6i = -2 - 1 = -3i = -3 = i = 1$

5. $5x - 2 = 3 + 4x$; [illegible]

7. $16 - 9R = 5R - 12$; $-9R - 5R = -16 - 12$; $\frac{-14R}{-14} = \frac{-28}{-14}$ $R = 2$

9. $27z + 22 = 30 + 17z$; $27z - 17z = 30 - 22$; $\frac{10z}{10} = \frac{8}{10}$ $z = .8$

11. $16p - 3 = 6p + 8 - 23p$; $16p + 17p = 8 + 3 = \frac{33p}{33} = \frac{11}{33}$ $p = \frac{1}{3}$

13. $10c - 17 = 9 - 3c$; $10c + 3c = 9 + 17 = 13c = 26$ $c = 2$

15. [illegible]

17. [illegible]

EXC- 6-5 (CONTINUED)

10. $E + e^2 = IR_1 + IR_2 + e1 \quad e1 = E + e^2 - IR_1 - IR_2$

11. $H = .0573 I^2 R t \quad R = \frac{H}{.0573 I^2 t}$

12. $eb = Eb - iRL \quad RL = eb - Eb$

13. $Yf = Yb - 2m \quad Yb = Yf + 2$

14. $L = 1.25 N^2 P \cdot 10^{-8} \quad P = \left(\frac{L}{1.25 N^2}\right) 10^8$

15. $R = \frac{KL}{m} \quad L = \frac{Rm}{K}$

16. $f = \frac{PN}{120} \quad P = \frac{f 120}{N}$

17. $C = \frac{Q}{V} \quad Q = CV$

18. $P = \frac{E^2}{R} \quad R = \frac{E^2}{P}$

19. $H = \frac{4\pi N i}{l} \quad N = \frac{Hl}{4\pi i}$

20. $Q = \frac{\omega L}{R} \quad R = \frac{\omega L}{Q}$

21. $C = .08842 K \frac{A}{D} \quad K \frac{CD}{.08842 A}$

22. $I = \frac{E - e}{R} \quad R = \frac{E - e}{I}$

23. $E = \frac{BLV}{10^8} \quad B = \frac{E 10^8}{LV}$

24. $\lambda = \frac{V}{f} \quad V = \lambda f$

25. $Gm = \frac{u}{R_p} \quad u = Gm R_p$

26. $\omega = \frac{B^2 AL}{8u} \quad u = \frac{B^2 AL}{608}$

27. $X_c = \frac{1}{2\pi f C} \quad f = \frac{1}{2\pi X_c C}$

28. $E_c = \frac{-E_{sg}}{u_{sg}} \quad u_{sg} = \frac{-E_{sg}}{E_c}$

29. $\frac{I_p}{I_s} = \frac{N_s}{N_p} \quad N_s = X ; \quad I_p \cdot N_p = I_s \cdot X ; \quad X = \frac{I_p \cdot N_p}{I_s}$

30. $\frac{E_p}{E_s} = \frac{N_p}{N_s} \quad N_s = E_p \cdot X = E_s \cdot N_p = X = \frac{E_s \cdot N_p}{E_p}$

CONT.

EX. 6-5 CONT.

31. $F = \frac{m m'}{d^2}$ $\quad m = \frac{F d^2}{m'}$

32. $w = \frac{2\pi r}{T}$ $\quad T = \frac{2\pi r}{w}$

33. $\omega = \frac{\theta}{t}$ $\quad \theta = \omega t$

34 $\omega = 2\pi n$ $\quad n = \frac{\omega}{2\pi}$

35. $V^2 = 2gh$ $\quad h = \frac{V^2}{2g}$

36. $K.E. = \frac{1}{2} m v^2$ $\quad m = \frac{KE}{\frac{1}{2} V^2}$ $\quad \left(\frac{2KE}{V^2}\right)$

37. $V = \frac{V_1 + V_0}{2}$ $\quad V_0 = V_2 - V_1$ $\quad \left(P = \frac{6+10}{2}\right)$ $\quad 10 = 8 \times 2 - 6 = 16 - 6 = 10$

38 $\frac{2 K.E}{I} = w^2$ $\quad K.E = \frac{w^2 I}{2}$

39. $F = m w^2 r$ $\quad m = \frac{F}{w^2 r}$

40. $m = \frac{F}{4\pi^2 n^2 r}$ $\quad r = \frac{F}{4\pi^2 n^2 m}$

41. $P = \frac{N+n}{2C}$ $\quad C = \frac{N+n}{2P}$

42. $I = \frac{M-2}{P}$ $\quad P = \frac{N-2}{I}$

43. $C = D + 2K$ $\quad K = \frac{C-D}{2}$

44. $C = \frac{D+d}{2}$ $\quad D = 2C - d$

45. $d = 2C - D$ $\quad C = \frac{D+d}{2}$

46. $L = nP$ $\quad P = \frac{L}{n}$

47 $DP = N$ $\quad P = \frac{N}{D}$

48. $t = \frac{T(c-F)}{c}$ $\quad T = \frac{ct}{c-F}$

49. $d = a + b - c$; $c = a + b - d$

50. $P = \frac{N+2}{H}$ $\quad H = \frac{N+2}{P}$

51. $P = A - I$ $\quad I = A - P$

52. $I = Prt$ $\quad r = \frac{I}{Pt}$

53. $M = \frac{Kl}{r}$ $\quad l = \frac{Mr}{K}$

OVER

EXC- 6-5 (CONT)

54. $I = Ad\pi \qquad \pi = \frac{I}{4d}$

55. $G^2 = ab \qquad a = \frac{G^2}{b}$

56. $A = \pi a b \qquad a = \frac{A}{\pi b}$

57. $T = ph + 2A \qquad A = \frac{T - ph}{2}$

58. $S = 2\pi r h \qquad r = \frac{S}{2\pi h}$

59. $b^2 = c^2 - a^2 \qquad a^2 = c^2 - b^2$

60. $a = \frac{2A}{b} \qquad A = \frac{ab}{2}$

EXC- 6-6

1. (a) $\frac{8}{10} = .8 = 80\%$

(b) $\frac{6}{12} = \frac{1}{2} = .5 = 50\%$

(c) $\frac{4}{6} = \frac{1}{3} = .666 \quad 66.6\%$

(d) $\frac{12}{9} = 1\frac{1}{3} = 1.33 = 133.33\%$

(e) $\frac{175}{50} = 3\frac{1}{2} = 3.5 = 350.\%$

(f) $\frac{1}{3} = .33 = 33\%$

(g) $\frac{50}{200} = \frac{1}{4} = .25 \quad 25\%$

(h) $\frac{18}{72} = \frac{1}{4} = .25 \quad 25\%$

EXC. 6-7

3. (a) $\frac{x}{18} = \frac{5}{6} \qquad 18.5 = 6 \cdot x \qquad = \frac{18.5}{6} = (15)$

(b) $\frac{y}{10} = \frac{7}{2} = \frac{10.7}{2} = (35)$ (c) $\frac{a}{4} = \frac{9}{12} = \frac{4 \times 9}{12} = (3)$

(d) $\frac{2.5}{a} = \frac{4}{3} = \frac{2.5 \times 3}{4} = (1.875)$ (e) $\frac{4}{.08} = \frac{.7}{x} = \frac{.08 \times .7}{4} = (.014)$

(f) $\frac{.9}{.35} = \frac{72}{m} = \frac{.35 \times 72}{9} = (28)$ (g) $\frac{c}{1.5} = \frac{8}{3} = \frac{1.5 \times 8}{3} = (4)$

(h) $\frac{d}{15} = \frac{.25}{12} = \frac{15 \times .25}{12} = (.312)$

(i) $\frac{5}{e} = \frac{6.25}{3} = \frac{5 \times 3}{6.25} = (2.54)$

EXC- 6-8

1. $D = 10R$
2. $D = 30T$
3. $W = 20w$
4. $W = wn$
5. $C = 2\pi R$
6. $A = \pi R^2$
7. $n = Kf$
8. $R = \frac{K}{A}$
9. $I = \frac{K}{d^2}$
10. $h = \frac{K}{d}$